

Dec. 9, 1969

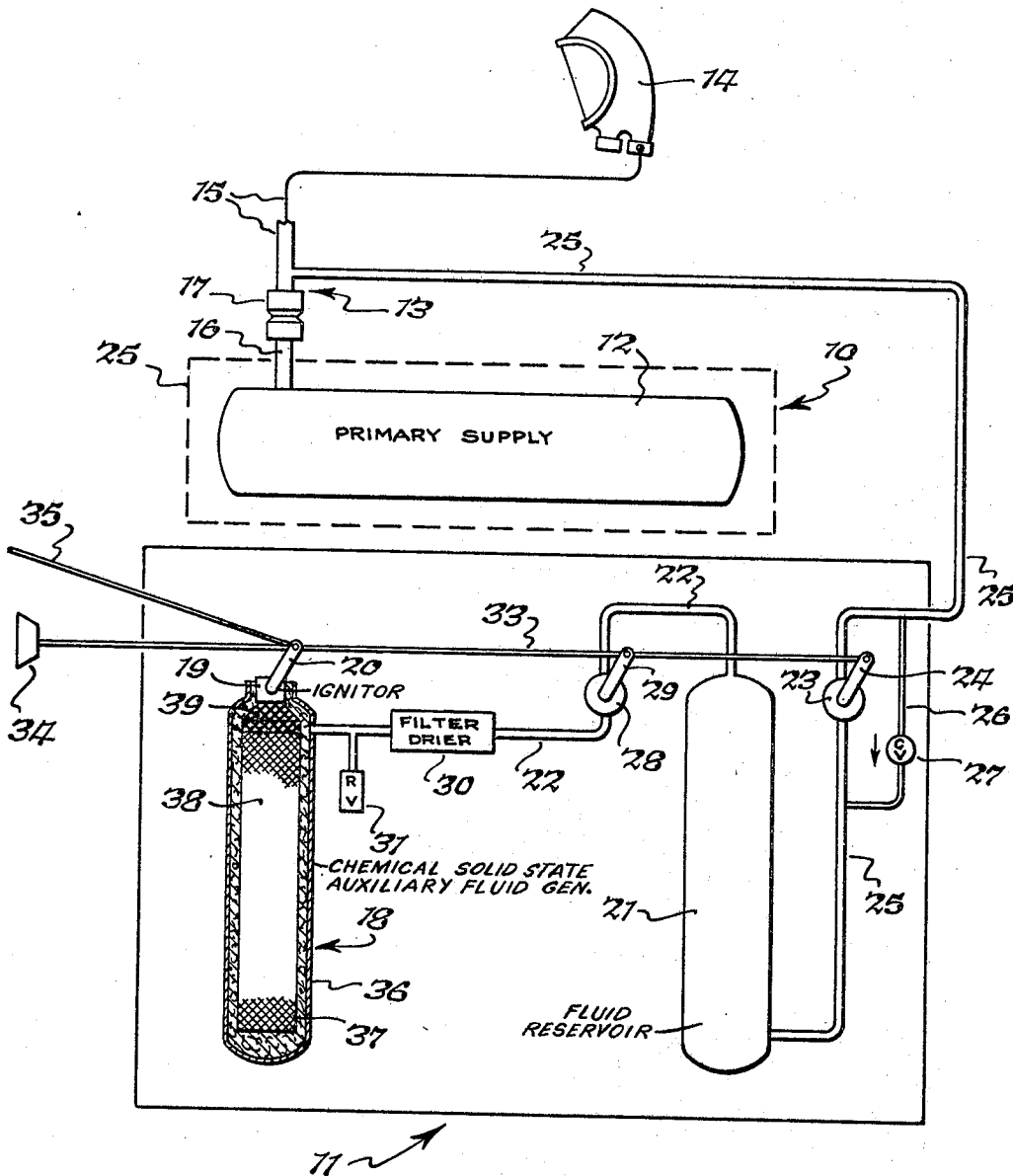
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3,482,568

SOLID STATE OXYGEN SUPPLY SYSTEM

Filed April 3, 1967

3 Sheets-Sheet 1



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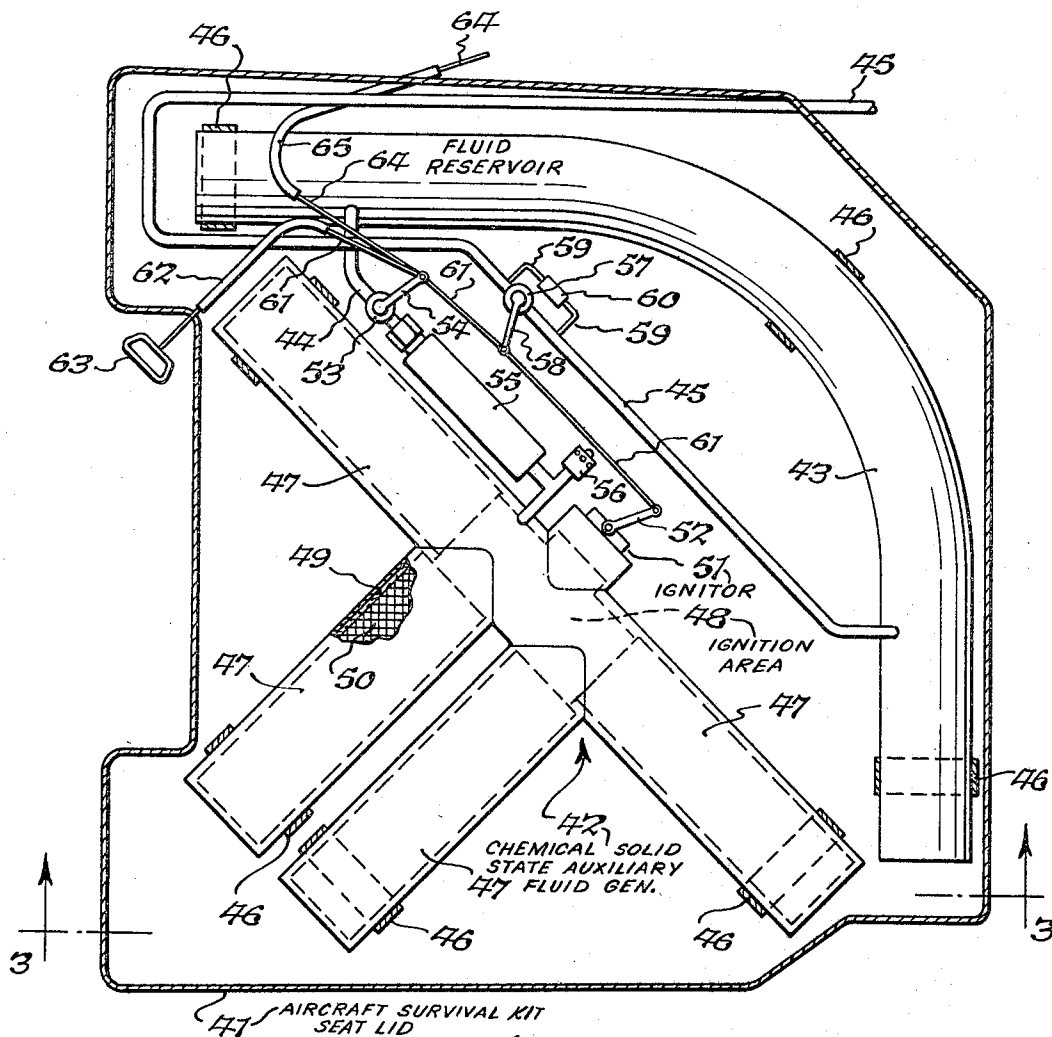


Fig. 2.

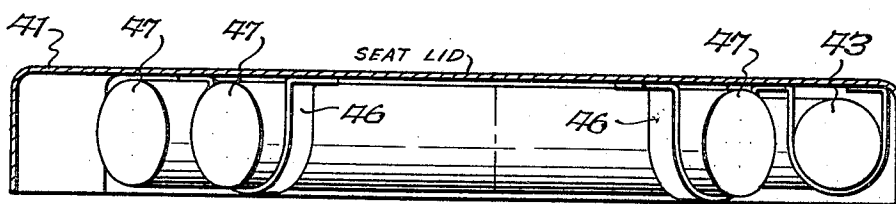


Fig. 3.

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3 Sheets-Sheet 3

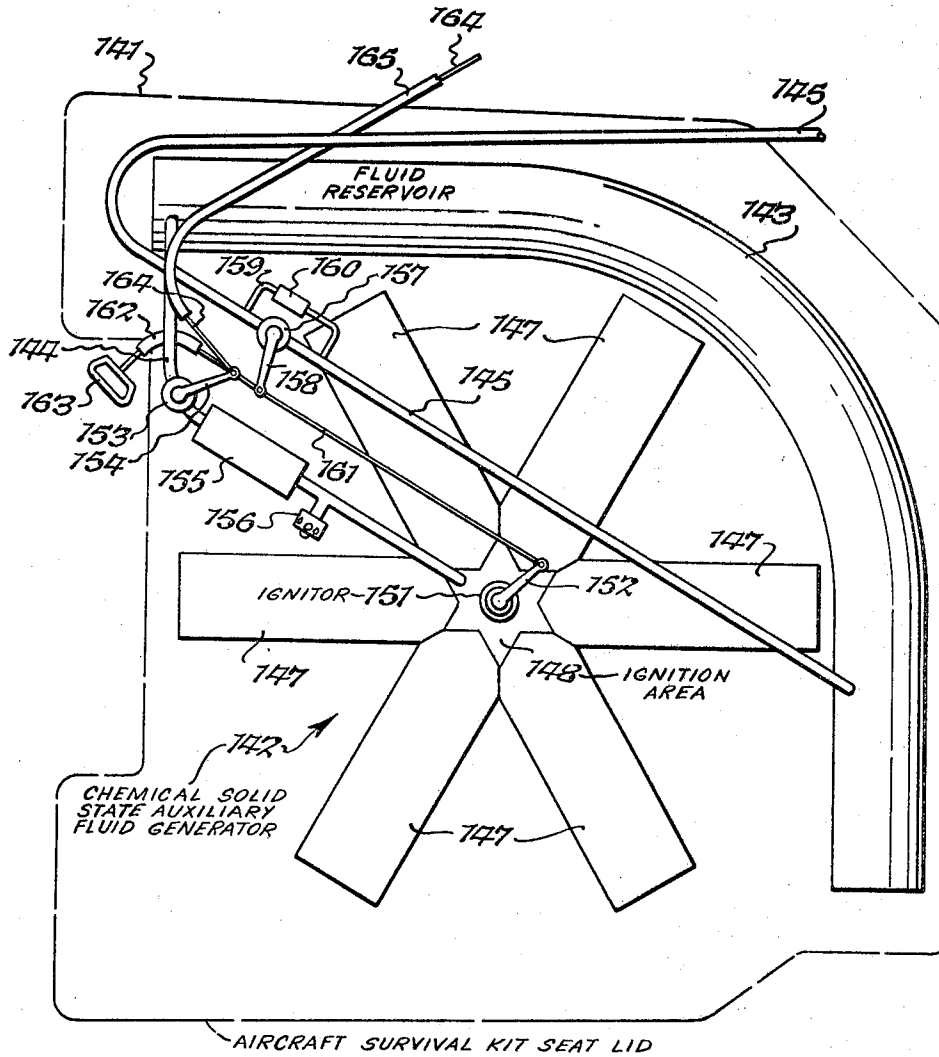


Fig. 4.

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3,482,568

SOLID STATE OXYGEN SUPPLY SYSTEM

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U.S. Cl. 128—142.3

12 Claims

ABSTRACT OF THE DISCLOSURE

An auxiliary oxygen supply system having a solid state chemical oxygen generator and a reservoir is fastened in the lid of a survival seat in an aircraft and is operable manually or automatically upon pilot ejection to provide oxygen to the face mask worn by the pilot. The reservoir is continuously charged with oxygen from a primary supply and is in communication with the face mask to provide oxygen instantaneously upon actuation of the auxiliary system and during the time required for the generator to attain an adequate oxygen generating rate. The oxygen generator can comprise a plurality of separate generating canisters providing a sustained, and substantially constant flow rate and having a common ignition area.

BACKGROUND OF THE INVENTION

This invention relates to a breathing fluid supply system and particularly to a self-contained auxiliary breathing fluid supply system including a chemical solid state breathing fluid generator adapted but not limited for use aboard an aircraft.

An auxiliary breathing fluid supply for aircraft is desirable for emergency use as a substitute for a primary breathing fluid supply and as a portable self-contained supply system carried by a pilot upon bailout. A chemical, solid state, breathing fluid source is particularly desirable for use in an auxiliary system as it is inert and can be stored for long periods of time without maintenance and reliability checks. Size, weight, system capacity and compatibility with the primary supply system are prime considerations in providing such auxiliary system particularly in view of the space and weight limitations imposed by modern aircraft. While solid state breathing fluid generators are ideally suited for an auxiliary supply system under these conditions, their optimum configuration within the aircraft and their inherent time lag in attaining an adequate breathing fluid generating rate after actuation poses problems to my knowledge heretofor unsolved.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a breathing fluid supply system having a solid state chemical breathing fluid generator wherein the system provides breathing fluid to a user substantially instantaneously upon actuation thereof.

It is another object of the present invention to provide an auxiliary breathing fluid supply system having a solid state, chemical, breathing fluid generator, the system being configured to minimum size and weight and having a breathing fluid generating capacity sufficient to meet aircraft emergency and bailout requirements.

It is still another object of the present invention to provide an auxiliary breathing fluid supply system having a solid state, chemical, breathing fluid generator which is adapted for placement in the lid of a rigid survival kit seat provided in an aircraft and which is configured to provide a substantially constant breathing fluid generating rate for the life of the generator.

It is a further object of the present invention to pro-

vide an auxiliary breathing fluid supply system having the foregoing characteristics and which can be manually actuated for emergency use and automatically actuated upon ejection during bailout.

In one aspect thereof, a breathing fluid generating system of the present invention is characterized by a primary fluid supply, an auxiliary chemical solid state fluid generator, a reservoir, fluid conduit means communicating with the chemical generator, the primary supply and the reservoir and having an outlet adapted for connection to a user, the conduit means being arranged to normally continuously provide fluid from the primary source to the reservoir, a valve disposed in the conduit means normally preventing communication between the reservoir and the outlet, and means for opening the valve and actuating the chemical generator to the outlet with the reservoir initially providing such fluid during the time required for the generator to attain a sufficient generating rate adequate for the user.

In another aspect thereof, a breathing fluid generating system of this invention is characterized by a plurality of elongated canisters containing solid state breathing fluid generating material, the canisters being arranged to lie in the same plane, an ignition area common to said canister, the canisters having end portions contiguous to and spaced about the ignition area for substantially simultaneous ignition of the canisters, means for igniting the ignition area, and means for collecting breathing fluid generated from the canisters after ignition thereof.

The foregoing and other objects, advantages and characterizing features of the breathing fluid generating construction of the present invention are pointed out in the following detailed description of two typical embodiments thereof considered in conjunction with the accompanying drawing depicting the same wherein like numerals represent like parts throughout the various views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of a breathing fluid system incorporating the features of the present invention with parts thereof shown in cross section;

FIG. 2 is a horizontal cross sectional view of one form thereof configured for placement in the lid of an aircraft survival kit;

FIG. 3 is a view thereof taken about on line 3—3 of FIG. 2; and

FIG. 4 is a plan view of another form thereof also configured for placement within the confines of a seat lid shown in broken lines.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, a breathing fluid supply system arranged in accordance with the principles of the present invention and adapted for use in an aircraft, although by no means limited thereto, is schematically illustrated in FIG. 1. The system comprises a primary breathing fluid supply system enclosed within the broken lines and generally designated 10 and an auxiliary breathing fluid supply system generally designated 11, the latter being enclosed within solid lines. Primary supply system 10 comprises a primary breathing fluid supply source 12 which may include conventional pressurized oxygen bottles as in the fixed ship supply system in an aircraft or an industrial air supply, neither being specifically shown, and a primary supply line generally designated 13 communicating between primary supply 12 and a face mask 14 worn by a user thereof. When used in an aircraft, auxiliary system 11 is preferably secured within a pilot's seat survival kit, as will be presently described with reference to FIGS. 2-4, and is thus carried by the pilot and separable from the aircraft with the pilot upon ejection

from the aircraft. To this end, supply line 13 is separable into two segments 15 and 16 by a conventional quick connect-disconnect coupling 17 with segment 15 adapted to be carried by the pilot and segment 16 adapted to remain fixed to the aircraft.

Auxiliary system 11 comprises a solid state chemical breathing fluid or oxygen generator generally designated 18, having a mechanical ignitor 19 with an actuating handle 20 and in communication with an oxygen reservoir 21 via a conduit 22. A normally closed valve 23 having an operating handle 24 is disposed in a conduit 25 which is suitably connected at one end to primary supply line 13 by a releasable fitting, not shown, and at its other end to reservoir 21. Under normal operating conditions, reservoir 21 is in communication with primary supply 21 through a by-pass line 26 having a check valve 27. In this manner, reservoir 21 is normally continuously supplied with oxygen from primary source 12 with check valve 27 preventing outflow of oxygen therefrom through line 26.

A normally closed valve 28 having an operating handle 29 is disposed in conduit 22 and prevents oxygen flow from reservoir 21 into oxygen generator 18. A filter dryer 30 and relief valve 31 are also disposed in conduit 22, dryer 30 comprising a chemical absorbent or reactant to remove small amounts of water vapor and contaminants in the oxygen produced by generator 18. Relief valve 31 releases oxygen generated by generator 18 in excess of demand. Valve operating handles 20, 24 and 29 are connected for operation in unison by a cable 33 terminating in a pull ring 34 for simultaneous manual actuation of oxygen generator 18 and valves 23 and 28. For automatic actuation thereof when the system is used in an aircraft, a lanyard 35 is connected at one end to handle 20 with the other end adapted for connection to a fixed part of the aircraft whereby actuation of generator 18 and valves 23 and 28 is effected automatically upon separation of auxiliary system 11 from the aircraft as when the pilot ejects therefrom.

Oxygen generator 18 comprises a metallic or ceramic canister 36 having a suitable interior lining of filter and insulating material 37, such as fibreglass. Canister 36 preferably contains a composition generally designated 38 of a chlorate or a perchlorate which generates oxygen upon combustion, a metal powder such as iron or carbon for burning and supplying part of the heat needed for combustion, a binder such as an inorganic glass fiber for holding the mass together and aiding in the even decomposition of the chlorate or perchlorate, and a peroxide for chemically eliminating the traces of chlorine gas released during thermal breakdown of the chlorate or perchlorate. Such oxygen candle compositions are known and per se no part of this invention. In the form illustrated in FIG. 1, an ignition section 39 is formed at the upper end of canister 36 and comprises the foregoing composition enriched with metal powder, such as iron, to provide a concentrated area of intense heat when ignited. Ignitor 19 can be of the percussion type operable in response to the movement of handle 20, this being conventional as typified by the bouchon of a hand grenade, the details of which are known, form no part of the present invention per se and accordingly require no further description. Other known ignitors may be also utilized such as a phosphorous match disc, an electric squib or the like.

The primary oxygen supply 12 normally provides oxygen to a user, and with valves 23 and 28 closed, reservoir 21 is continuously supplied with oxygen from the primary source 12 via supply line 13, conduit 25, and by-pass line 26. Should a pressure drop or other malfunction occur in primary oxygen system 10, auxiliary system 11 can be manually actuated to ignite generator 18 and open valves 23 and 28 by pulling ring 34. When the system is utilized in an aircraft, should the pilot eject and thereby separate auxiliary system 11 from the aircraft, auxiliary system 11 is actuated automatically by traction on lanyard 35 to

open valves 23 and 28 and ignite oxygen generator 18. In both instances, oxygen is immediately provided to face mask 14 under pressure from reservoir 21, through conduit 25, valve 23, and segment 15. Oxygen from reservoir 21 is thus immediately available to a user upon actuation of auxiliary system 11. Reservoir 21 has a capacity sufficient to provide oxygen to a user at the normal primary supply pressure during the short time required for generator 18 to attain an oxygen generating rate sufficient to replenish the oxygen in reservoir 21 as it is being used.

Referring now to FIGS. 2 and 3, there is shown one form of the auxiliary oxygen supply system schematically illustrated in FIG. 1 specifically configured for placement within a lid 41 of a conventional aircraft rigid seat survival kit, the lower portion of which is not shown as it forms no part of the present invention. An oxygen generator generally designated 42, an elongated cylindrical reservoir 43, a conduit 44 connecting one end of reservoir 43 with oxygen generator 42 and a conduit 45 adapted to connect the other end of reservoir 43 with a primary supply line, such as line 13 shown in FIG. 1, are suitably secured within lid 41 as by brackets 46 or the like which are riveted or otherwise secured to the underside of lid 40. It will be appreciated that survival kits are constructed to occupy minimal space in the aircraft and that the lids thereof are on the order of fifteen by seventeen inches in lateral dimensions and generally about two inches deep.

In order to dispose a chemical oxygen generator within such limited confines and still maintain a sustained generating rate sufficient to provide an adequate quantity of oxygen for the desired period of time, generator 42 is configured to comprise a plurality of separate and identical cylindrical canisters 47 joined together and having a common ignition area 48. The canisters are arranged substantially as shown in FIG. 2 with a pair of canisters 47 lying in end to end relation on opposite sides of ignition area 48 and a second pair of canisters 47 lying at right angles to the first pair in the same horizontal plane with their ends abutting ignition area 48 which is also cylindrical in shape and coaxial with the first pair of canisters 47. Canisters 47, like canister 36 of FIG. 1, have a suitable insulating and filter liner 49 and contain an oxygen generating composition 50 similar to composition 38 previously described. With the foregoing physical arrangement of canisters 47, equal area burning surfaces are present to ignition area 48 and composition 50 in canisters 47 will burn at an equal rate for the length thereof providing a constant oxygen generating rate which is sustained over the desired time period. Ignition area 48 has a conventional percussion mechanical ignitor 51 and operating handle 52 similar to ignitor 19 and handle 20 of FIG. 1.

To fit reservoir 43 within lid 41 and retain sufficient volumetric capacity to supply oxygen to the pilot during the short time interval between actuation of the auxiliary system and the attainment of a sufficient oxygen generating rate in generator 42, reservoir 43 is arcuately bent approximately 90° to substantially follow a pair of edges of lid 41 substantially as shown in FIG. 2. A normally closed valve 53 having an operating handle 54, a filter dryer 55, and a relief valve 56 are disposed in conduit 44. A normally closed valve 57 having an operating handle 58 and a valve by-pass line 59 having a check valve 60 are disposed in conduit 45. A cable 61 connects handles 54, 58 and 52 and passes through a guide 62 suitably secured within lid 41 to terminate in a pull ring 63 outside of lid 41. A lanyard 64 is fastened at one end to handle 54 and passes through a guide 65 outwardly of lid 41 for attachment to the aircraft.

In use, the pilot is normally supplied with oxygen from a primary supply, shown at 12 in FIG. 1, and reservoir 43 is continuously supplied with oxygen from the primary source via conduit 45, by-pass line 59 and check valve 60, valves 57 and 53 being normally closed. The auxiliary oxygen supply system can be manually or automatically actuated to ignite oxygen generating canisters 47 and open

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valves 53 and 57 by pulling ring 63 or by traction on lanyard 64 respectively. In both instances, oxygen is immediately supplied to the pilot from reservoir 43 through conduit 45 and the now open valve 57, there being sufficient capacity in arcuate reservoir 43 to adequately supply the pilot with oxygen during the time required for generator 42 to attain a sufficient generating rate.

It will be noted that with the foregoing arrangement of canisters 47, their end faces abut ignition area 48 and are ignited substantially simultaneously. In this manner, canisters 47 will burn simultaneously and at a constant rate substained over the same time interval, to thereby together provide a sufficient volume of oxygen to the pilot.

The form of auxiliary oxygen generating system illustrated in FIG. 4, has equivalent and corresponding parts to the form shown in FIGS. 2 and 3, which parts have been given the same reference numerals preceded by the numeral 1. As the operation and function of valves 153, 157 and 160 together with their actuating means including ring 163, lanyard 164, cable 161 and handles 154, 158, and 152 and the general arrangement of the conduits 144 and 145, dryer 155, relief valve 156 are similar to the corresponding parts in the form illustrated in FIGS. 2 and 3, it is believed that no further description thereof is necessary.

The solid state chemical oxygen generator 142, in this form, comprises a plurality of oxygen canisters 147 arranged at equal angularly spaced intervals about a central ignition area 148. Canisters 147 contain the oxygen generating composition and the filter and insulator, similar to the canisters 47 of FIGS. 2 and 3, but are somewhat fore-shortened in comparison with canisters 47 so that they can be disposed in this star-like configuration within the limited confines of lid 141 indicated by the broken lines, there being a greater number of canisters 147 in this form than in the previous form to compensate for the reduction in length and still retain substantially the same capacity. Canisters 147 are preferably square in cross section but, of course, may have circular or other cross sectional configurations as desired.

An ignitor 151 is provided in the central portion of ignition area 148, ignitor 151 being preferably of a conventional percussion type and ignition area 148 being star-shaped to thereby expose a larger area of the end faces of each oxygen generator for ignition.

As in the previous form, actuation of ignitor 151 by traction on cable 161, either manually or automatically via ring 163 or lanyard 164 respectively, causes ignition area 148 to simultaneously ignite the inner end faces of oxygen evolving compositions in canisters 147 whereby a constant generating rate is sustained for the burning life of canisters 147. Oxygen is provided from reservoir 143 to the pilot via conduit 145 immediately upon actuation of the auxiliary system with the oxygen generating canisters 147 replenishing reservoir 143 via conduit 144 and open valve 153 at a sustained sufficient rate shortly after such actuation. It is apparent that any number of canisters could be arranged equidistantly about central ignition area 148 with the lengths and cross sections thereof being varied to provide a combined oxygen generating face equal to the combined area of the oxygen generating faces of the six illustrated canisters and thus sufficient to provide a sustained and adequate oxygen generating rate over the desired time period as in the illustrated form. Also, the different individual generators in a particular grouping thereof need not be identical, the burning of different oxygen generating candles can be varied, in a manner known in the art.

It is thus seen that the objects of my invention are fully accomplished and that there is provided an auxiliary oxygen supply system having a solid state oxygen generator which provides oxygen to a user substantially instantaneously upon actuation thereof. The auxiliary system is optimally configured for a given space limita-

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tion, such as the lid of an aircraft survival seat, and for a pilot's oxygen requirements during bailout and emergencies. Moreover, the foregoing has been arranged for automatic or manual actuation.

Having thus described and illustrated two preferred forms of my invention, it will be understood that such description and illustration is by way of example only and that such modifications and changes as may suggest themselves to those skilled in the art are intended to fall within the scope of the present invention which is limited only by the appended claims.

What I claim as new is:

1. In a fluid supply system, a primary fluid supply, a chemical solid state auxiliary fluid generator, a fluid reservoir, fluid conduit means communicating with said chemical generator, said primary supply and said reservoir and having an outlet adapted for connection to a user of fluid generated by said generator, said conduit means being arranged to normally continuously supply fluid from said primary source to said reservoir, a conduit control valve normally preventing the supply of fluid from said reservoir to said outlet, and means for opening said valve and substantially simultaneously actuating said chemical generator to supply fluid from said reservoir and said chemical generator to said outlet with said reservoir initially supplying such fluid during the time required for said generator to attain a sufficient generating rate adequate for the user.

2. A fluid supply system according to claim 1 wherein said fluid conduit means includes a first conduit connecting said fluid generator and said reservoir, and a second conduit connecting said reservoir to said outlet, fluid generated by said generator being supplied to said reservoir through said first conduit and then through said second conduit to said outlet.

3. A fluid supply system according to claim 1 wherein said valve opening means includes a valve operator and said actuating means includes an ignitor for said generator, and means interconnecting said operator and said ignitor for simultaneous actuation of said control valve and generator.

4. A fluid supply system according to claim 3, together with another control valve normally preventing communication between said generator and said reservoir, said other valve being interconnected with said operator and said ignitor for opening substantially simultaneously with actuation of said generator.

5. A fluid supply system according to claim 1 wherein said outlet comprises a face mask and said chemical generator is a breathing fluid generator.

6. A breathing fluid supply system according to claim 5 wherein said generator comprises a plurality of canisters containing breathing fluid generating material and said reservoir comprises a container, and means supporting said reservoir and said canisters to lie in a common plane.

7. A breathing fluid supply system according to claim 6 wherein said actuating means includes an ignition area common to said canisters and lying in said common plane, said canisters having end portions contiguous to and spaced about said ignition area for substantially simultaneous ignition of said canisters.

8. A breathing fluid supply system according to claim 7 wherein said fluid conduit means includes a first conduit connecting said canisters and said reservoir, and a second conduit connecting said reservoir to said outlet, breathing fluid generated in said canisters being supplied to said reservoirs through said first conduit and then to said face mask through said second conduit.

9. A breathing fluid generating system comprising a plurality of elongated canisters containing solid state breathing fluid generating material, said canisters being arranged to lie in a common plane, an ignition area common to said canisters, said canisters having end portions contiguous to and spaced about said ignition area for

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substantially simultaneous ignition of said canisters, means for actuating said ignition area, and means for collecting breathing fluid generated from said canisters after ignition thereof.

10. A breathing fluid generating system according to claim 9 wherein said collecting means comprise a reservoir lying substantially in the plane of said canisters.

11. A breathing fluid generating system according to claim 10, wherein said canisters and said reservoir are contained within the seat lid of an aircraft survival kit.

12. A breathing fluid generating system according to claim 10, wherein said ignition area also is substantially in the plane of said canisters.

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References Cited

UNITED STATES PATENTS

645,545	3/1900	Blackie	23—281
2,507,450	5/1950	Millikan et al.	128—203
2,818,066	12/1957	Glidden	128—142.3
3,367,328	2/1968	Mangieri	128—142.5

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